Name:____________________

Date:________________

EO 3513

COMPUTER-AIDED LABORATORY 1 (lab1.m)
Signal and Spectrum Generation

I. Discussion

This series of laboratory experiments uses MATLAB^{tm} files which are part of the Communications Toolbox for MATLAB being developed in the NPS Advanced Communications Laboratory. The files necessary to run these laboratories are contained in a directory titled **eo3513** and will run under MATLAB 4.2 for Windows. The **eo3513** directory must be included in the MATLABPATH command in the matlabrc.m file (see MATLAB reference manual) on the platform you are using.

These laboratories are written as what are known as "MATLAB script m-files", and you really don't need to know any MATLAB to run them. They are interactive. During their execution, you will be asked to enter numerical values for things like frequency, pulse width, etc. and to set up time and frequency scales.

The m-file for this laboratory is **lab1.m**. To execute, simply type **lab1** at the MATLAB prompt. You can find the file in the **eo3513** directory. It may be useful to print it out before you begin.

Part 1: Signal generation

In this part, the signals

$$s1=A_1*\cos(2\pi f_1 t)\ ,\ s2=A_2\cos(2\pi f_2 t)\ \text{and}\ s3=A_3\cos(2\pi f_3 t)$$

are generated and will be plotted as Plot 1 of Figure 1. You are asked to enter the values for the frequencies and the amplitudes.

Before a signal can be plotted as a function of t, we have to establish a range for t. You will be asked to enter the minimum and maximum value for t. Also, computers can't really make analog waveforms, that is compute the values of the signals for every possible value of t. So you need to establish a time increment dt between points. You will be asked to enter dt. You should choose dt so that there are between 500 and 2000 points in time interval between the minimum and maximum value of t. You should also choose values for the frequencies that are in the range of f=F/500 to f=F/10 where F=1/dt.

After the individual cosine waves have been generated and plotted, the multitone signals;

s4=s1+s2 and s5=s1+s2+s3

will be generated and plotted as Plot 2 of Figure 1.

Part 2: Spectrum generation

The Fourier transforms of s1, s2 and s3 are computed and their magnitudes are plotted, sequentially, in three different colors, as Plot 3 in Figure 2. Then the Fourier transform of s5 is computed and plotted as Plot 4 in Figure 2. You will be asked to enter the maximum value of frequency for your frequency scale. Make this smaller than F from above but bigger than the largest of the three frequencies f1,f2 and f3 so that all the data will show in the graph.

Part 3: Flat top pulse; Signal s6

In this part, you will be asked to enter an amplitude and pulse width for a flat top pulse. Don't use a pulse width in excess of 50% of the length of your time interval (tmax-tmin) nor less than about 10% of the length of the interval. The pulse waveform will be plotted as Plot 5 in Figure 3 and the magnitude of the Fourier transform of the pulse will be plotted as Plot 6 in Figure 3.

II. Procedure

1. Typical Values

a. Run the program **lab1** using the following values for the parameters;

Part I:

tmin=0

tmax=0.1

dt= 0.0001

f1= 40

A1= 5

f2= 80

A2= 2

f3= 150

A3= 1

Part II:

Fmax=200

Part III:
Pulse width
T= .02

Pulse amplitude
A= 10

b. Plot the Fiqure windows using the print command.

2. Experimental Values

a. Run the program at least twice more using your own values for the parameters, observing the protocols discussed above. Record the values used above and plot the Figure windows.

III. Report

1. Compute the Fourier transforms for the signals s1 through s6 and sketch these Fourier transforms for the values of the typical parameters and the experimental parameters you have chosen. Clearly show all your equations and their evaluation for the parameters chosen.

2. Compare your theoretical calculations to the Figures. Are their any discrepancies in the amplitudes of the frequency components or in the frequencies of the single and multitone signals or the zero crossings of the spectrum of the flat top pulse signal? That is does experiment agree with theory? If not, try to explain why.